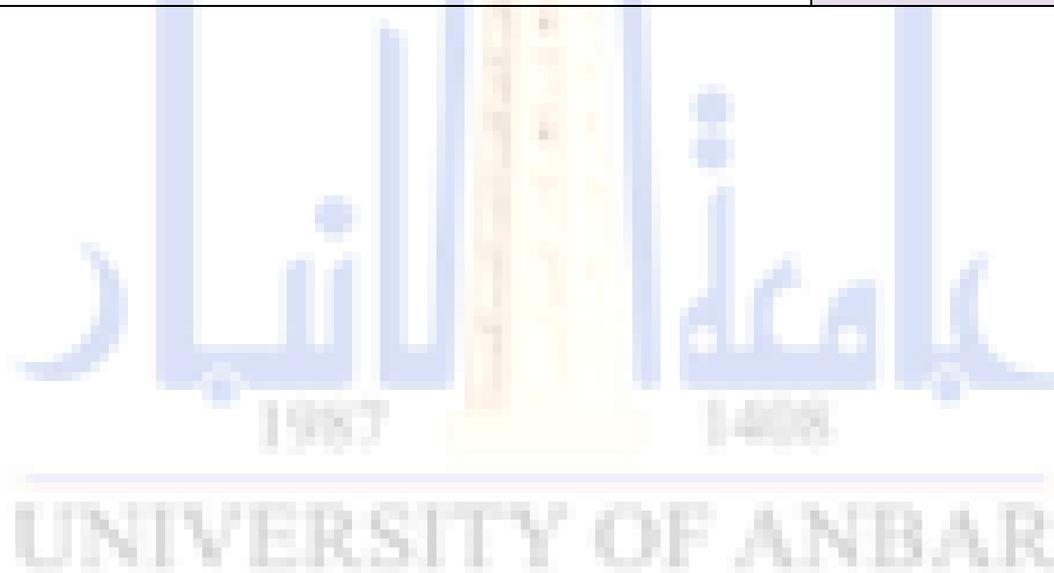


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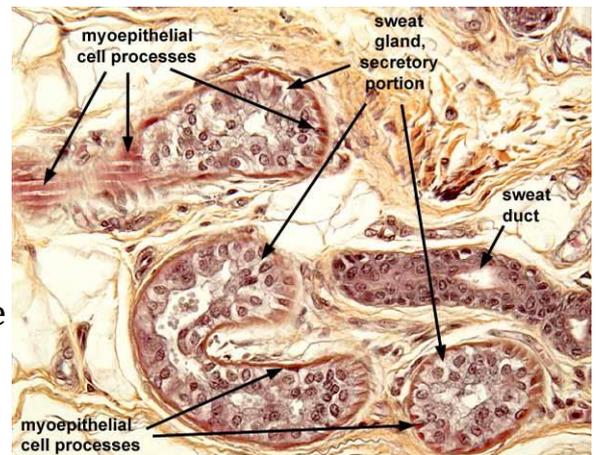
SPECIAL STRUCTURES OF SKIN

Skin includes several specialized structures, including epidermal appendages (sweat glands, hair follicles, nails) as well as blood vessels and nerve endings which travel through the dermis.

Sweat glands

Sweat glands are simple tubular glands lined by cuboidal epithelium. The secretory portion of the gland lies deep in the dermis, where the tubule is twisted into a fairly compact tangle. A duct communicates outward through the overlying dermis and the epidermis.

The secretory portion of a sweat gland is comprised of cells which are larger than those of the duct. These cells form a simple cuboidal epithelium, along with interspersed myoepithelial cells (which can expel sweat by contraction). Cells comprising the duct, or conducting portion of the tubule, usually form a two-layered stratified cuboidal epithelium



Sweat glands are vital for thermoregulation.
.They also influence water and ion balance

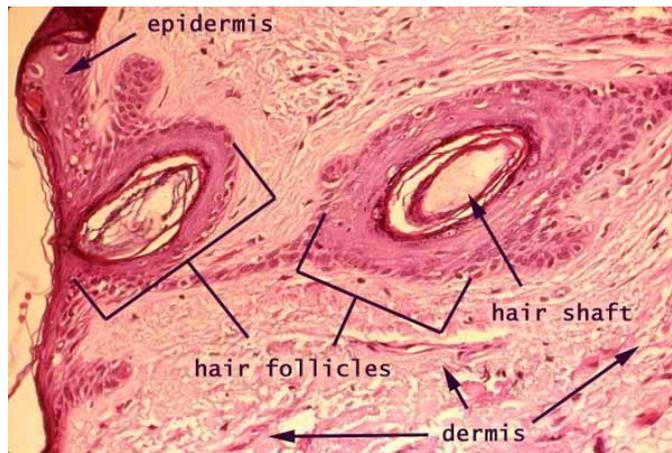
The primary function for sweating is evaporative cooling of the body. Thus, the amount of sweat is regulated as a function of body temperature

There are two types of sweat glands. Ordinary eccrine sweat glands are found over most of the body, while larger apocrine sweat glands are found in axillary, pubic, and perianal regions

Both types of sweat glands have the same basic shape, but apocrine glands have taller cells and much larger diameter.

Hair follicles

Hair follicles are tubular invaginations lined by stratified squamous epithelium similar to epidermis. Hair follicles are associated with sebaceous glands as well as nerve endings and smooth muscle, which all together form the pilosebaceous apparatus



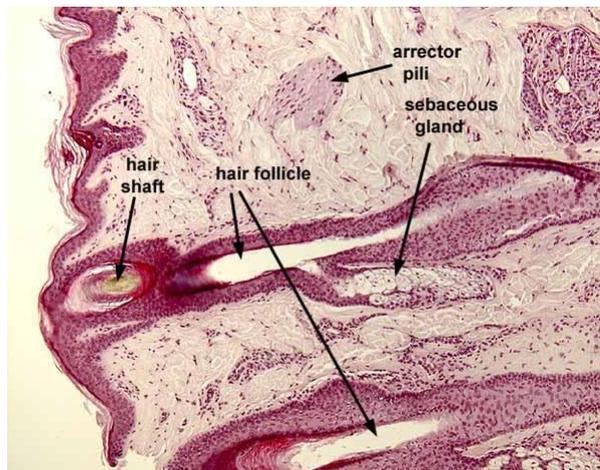
A **network** of nerve endings detects deflection of the hair shaft and also controls piloerection (hair "standing on end," or "goose bumps")

Piloerection is effected by smooth muscle. A small bundle of smooth muscle cells called the arrector pili ("hair erector") is attached to the connective tissue sheath around each hair follicle

Sebaceous glands secrete oil into the hair follicle.

Sebaceous glands

Sebaceous glands are associated with hair follicles. The complex of hair follicle, hair shaft, and sebaceous gland is sometimes called the **pilosebaceous apparatus**.



Histologically, sebaceous glands are quite different from all other glands. They are **holocrine glands**, which means that the *whole cell* is secreted. The secretion consists of breakdown-products of the cells themselves, which extrude into the lumen of the associated hair follicle. So, basically, sebaceous glands are small masses of epidermal cells in which sebum (a mixture of lipids) accumulates rather

than keratin

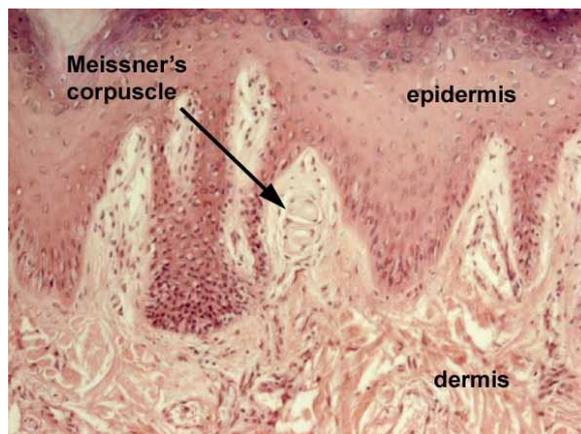
Innervation

The skin is richly innervated, served by a variety of **sensory nerve endings** which respond to a variety of modalities (e.g., pressure, vibration, heat, cold, itch, pain) and by **motor nerve endings** which control blood flow, sweat secretion, and piloerection.

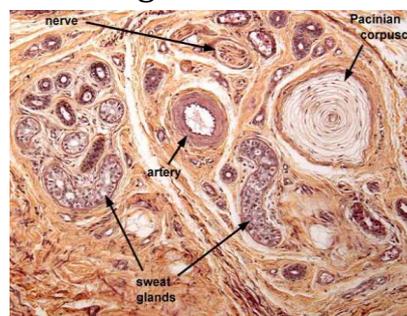
Free nerve endings (without any conspicuous associated structure) terminate within the **epidermis**, penetrating almost to the **stratum corneum**

Merkel's touch corpuscles are nerve endings associated with Merkel cells at the base of the epidermis in thick (glabrous) skin of palms and soles.

Meissner's corpuscles are encapsulated endings in dermal papillae, most common in palmar and plantar skin, especially in fingertips.



Pacinian corpuscles are simple nerve endings but are each encapsulated by multilamellar, ovoid structures resembling small onions. Pacinian corpuscles respond to deep pressure.



Krause's endbulbs or mucocutaneous receptors, are encapsulated endings in dermis, especially associated with lips, genital regions, nipples, and conjunctiva.

Ruffini endings have numerous fine branches from a single axon within the fluid-filled space of a single thin capsule.

Hair follicle receptors are unencapsulated nerve endings wrapped around hair follicles.

Peripheral nerves can often be found in dermis, with smaller branches toward the surface (i.e., often near sweat glands or hair follicles) and larger branches in deeper layers (often running parallel to blood vessels).

Skin vasculature

The papillary layer of the dermis is richly supplied with **capillaries**, while larger **blood vessels** may be found in deeper levels of the dermis, this rich vascular network serves mainly for regulation of body temperature. Essentially, regulation of the amount of blood flowing through superficial capillaries allows for either conservation or dissipation of body heat.

Functions of Skin

Skin serves several functions simultaneously.

- **Containment** -- Skin prevents loss of body fluid.
 - Although the stratum spinosum is permeable to water, the epidermis becomes relatively impermeable in the stratum granulosum and stratum corneum.
 - Damage to extensive areas of epidermis, *e.g.* by burns, renders the skin highly permeable and constitutes a medical emergency.
- **Protection** -- Skin resists abrasion and penetration, and blocks the entry of foreign material.

Epidermis serves as a simple mechanical barrier. This is probably the most obvious function for skin.

Keratinocytes are crucial for the barrier function, both in their tonofilaments and desmosomes which establish the mechanical integrity of the epidermis and in their formation of hardened squames in the stratum corneum.

Melanocytes produce melanin pigment, which shields underlying cells from ultraviolet light.